

IPC-2576

Sectional Requirements for Electronics Manufacturing Supply Chain Communication of As-Built Product Data - Product Data eXchange (PDX)



Endorsed by the National Electronics Manufacturing Initiative (NEMI)

IPC-2576

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A standard developed by IPC

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- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

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- Increase time-to-market
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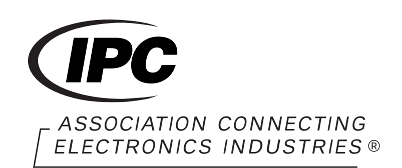
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IPC-2576

PDX
– As-Built Product Data

Sectional Requirements for Electronics Manufacturing Supply Chain Communication of As-Built Product Data – Product Data eXchange (PDX)

A standard developed by the Product Geneaology Exchange Task Group (2-15c) of the Supply Chain Communication Subcommittee (2-15) of IPC.

The IPC-2576 standard covers the sectional requirements for product genealogy, or as-built manufacturing information. This standard defines how manufacturing product genealogy information is exchanged between supply chain partners.

This project was initiated by the NEMI Virtual Factory Information Interchange Project (VFIIP) which established proof of concept. After completion, the project leaders recommended standardization by IPC under the ANSI rules and procedures.



Users of this standard are encouraged to participate in the development of future revisions.

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Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the Product Geneaology Exchange Task Group (2-15c) of the Supply Chain Communication Subcommittee (2-15) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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NIST

Product Geneaology Exchange Task Group

Co-Chairs
John Cartwright
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Martin Zimmerman, Nortel Networks

A special note of thanks goes to the following individuals for their dedication to bringing this project to fruition. We would also like to highlight those individuals who were involved with the initial NEMI program concept and made major contributions to the development of the standard.

Barbara Goldstein, NIST

John Cartwright, Intel Corporation

Doug Furbush, GenRad Corporation

Mike Stankavich, Intel Corporation

Ben Poole, SCI Systems

Frank McBryan, Nortel Networks

Mark Benzick, Nortel Networks

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Sectional Requirements for Electronics Manufacturing Supply Chain Communication of As-Built Product Data - Product Data eXchange (PDX)

Introduction

This standard defines an XML encoding scheme that captures the configuration data from manufacturing operations. The IPC-2576 standard defines how manufacturing product genealogy information is exchanged between supply chain partners. Information represented in this standard includes such things as: manufacturing site, manufacturing date, part number, serial number, manufacturing batch/lot, component and sub-assembly data.

The IPC-2571 dictates the required package structure and xml format for information exchange using any of the subsequent IPC-257x standards such as this one. In any such exchange, a Product Data eXchange package must be defined which contains at a minimum a single pdx.xml file. This file in turn is required to contain a single ProductDataeXchangePackage element, and may contain any number of other elements from this specification. The Product Data eXchange package may optionally contain or refer to related external files.

1 Scope

This standard covers the sectional requirements for product genealogy, or as-built manufacturing information. The standard facilitates the exchange of manufacturing information between supply chain partners to support warranty tracking, product excursion containment, and product quality functions.

2 Applicable Documents

The following documents contain provisions, which, through reference in this text, constitute provisions of this standard. All documents are subject to revision. Parties who make agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits.

IPC 2510 Generic Computer Aided Manufacturing Descriptions for Printed Boards and Printed Board Assembly.

IPC-2571 Generic Requirements for Electronics Manufacturing Supply Chain Communication - Product Data eXchange (PDX)

3 Graphical Representation of Product Data eXchange

The IPC-2571 is a mandatory part of this standard. The graphical representation of the entire Product Data eXchange standard suite is detailed in the IPC-2571.

Note that graphics and a table of attribute descriptions are provided as an aid to understanding the elements in the PDX standard suite. In any instance where the XML DTD conflicts with an image or description, the DTD should be considered normative.

Many of the attributes in the tables provided show Electronic Data Interchange (EDI) and/or RosettaNet aliases. The EDI X12 V4010 references in the Alias column represent some known EDI implementations

between trading partners that pass similar data as the attribute referenced. In general, trading partners must agree as to what information is transmitted via EDI and which forms, fields and codes are used for this purpose. The EDI X12 V4010 gives reference guidelines for established usage to facilitate this practice. This IPC specification goes beyond that which is typically transmitted via EDI and allows for greater information exchange between partners. All aliases provided are examples only and are provided only for representative purposes. They are not intended to be complete, definitive, or commonly accepted as substitutes for the given PDX attribute.

The following key explains the cardinality indicators in the diagrams shown within this standard:

Occurrence Indicator	Meaning
none	The element must appear once and only once.
?	The element (or group of elements) may appear zero or one times. The element is optional, but is only allowed to appear once.
+	The element (or group of elements) must appear one or more times. The element is required to appear at least once, but multiple consecutive occurrences may be present.
*	The element (or group of elements) may appear zero or more times. The element can appear as many times consecutively as needed, or even zero times.

4 Implementation Notes and Recommended Practices

The pdx.xml file contains a single header. A hierarchical XML structure has been used to uniquely identify the build data of each product. The following section describes the elements that may appear in the XML pdx.xml file for a product genealogy transmission.

In the AsBuiltProduct segment there will always be at least one ProductInstance that will relate to the Product. This structure will support multiple Shipments by having more than one AsBuiltProduct segment and it will support more than one purchase order within a Shipment. The Lot segment allows for serial, lot, vendor, etc. by using LotType to define different information collections. When a lot is changed, the ProductInstance should be split in order to keep the relationship synchronised.

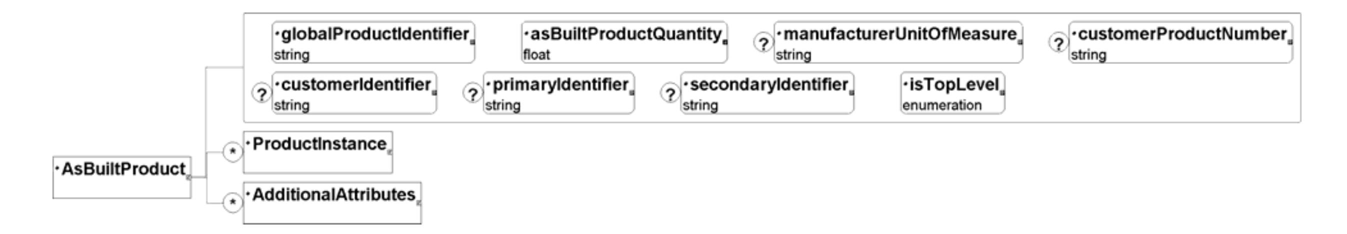
The structure can also support multiple layers by having more than one ProductInstance inside another ProductInstance. The issue of parsing down multiple BOM legs can cause a massive single message that may be difficult or impossible for other vendors to parse. It is recommended that only two levels be parsed, thereby creating only a single-level build. Since multiple records can be created then the size becomes manageable for both parsing and transmission. The lower layers can be created by separate rows or can be achieved via a request for more information. Trading partners will need to agree on the most appropriate approach, which is not dictated by this standard.

PDX was engineered with the understanding that it is unrealistic to expect a standard to meet every organization's needs, especially as those needs change with time. For that reason, the AdditionalAttributes and AdditionalAttribute elements are included in the standard (see IPC 2571) to allow user-defined extensions to any Product Data eXchange entity. The AdditionalAttribute element defines a single new attribute; AdditionalAttributes enables the grouping of these new attributes.

Note that the use of these elements in effect creates a custom version of the standard, and extensions defined in this manner will not interoperate with standard Product Data eXchange implementations. For

this reason, users are encouraged to use expansion mechanisms judiciously, and to recommend any desired additions to the IPC Product Data eXchange committee.

5 AsBuiltProduct Element



An AsBuiltProduct element describes a uniquely identified product, distinguishable by its globalProductIdentifier (which may be composed of a product number and a Global Trade Item Number (GTIN)). The ProductInstance element contains all the genealogy information of that item and can trace down to the lowest traceable component level.

Attribute Name	Type	Data Type	Description	Alias
globalProductIdentifier	CDATA	#REQUIRED	Product identifier as defined by the manufacturer	EDI X12 V4010:856 LIN04 – Id 235 Code:MG – Manufacturer's Part Number
asBuiltProductQuantity	CDATA	#REQUIRED	The number or count of the product manufactured.	EDI X12 V4010: 856 SLN04 - Quantity
ManufacturerUnitOf Measure	CDATA	#IMPLIED	Unit of measure for item (each, gallons, inches, etc.)	EDI X12 V4010: 856 SLN05 – Id 355 Unit or Basis for Measurement Code
customerProductNumber	CDATA	#IMPLIED	Product identifier as defined by customer	EDI X12 V4010: 856 LIN02 – Id 235 Code:BP - Buyer's Part Number
customerIdentifier	CDATA	#IMPLIED	Identifier which uniquely identifies the manufacturer's customer.	EDI X12 V4010: 856 N012 - Name
primaryIdentifier	CDATA	#IMPLIED	Shipment Tracking Identifier. This is a link to the shipment Advance Ship Notice (ASN).	EDI X12 V4010: 856 REF02 – Reference Identification
secondaryIdentifier	CDATA	#IMPLIED	Secondary Shipment Identifier. This is a link to the shipment Advance Ship Notice (ASN).	EDI X12 V4010: 856 BSN02– Shipment Identification
isTopLevel	Yes | No	#IMPLIED	See IPC 2571 for a discussion of the "isTopLevel attribute" (Default is No)	

6 ProductInstance Element



The ProductInstance element is an instance of a product and contains the genealogy information such as its identity, where it came from, what components it consists of, what date it was assembled, a description of the item, etc. The components or sub-assemblies of the product would just be listed as an instance of ProductInstance, therefore forming a recursive structure tracing all the components of the product to the lowest traceable component level.

Attribute Name	Type	Data Type	Description	Alias
proprietarySerialIdentifier	CDATA	#REQUIRED	The recorded serial number (or lot code) of the item This is the manufacturer's identifier for the product Instance being built.	
itemIdentifier	CDATA	#REQUIRED	This is the part number of a component of the assembly.	
itemUniqueIdentifier	IDREF	#IMPLIED	See IPC 2571 “Inclusion of Linked Objects”	
description	CDATA	#IMPLIED	Free form text indicating the functional or other aspects of the product.	
proprietaryProductFamily	CDATA	#IMPLIED	The name of the product family, or grouping of like products, to which this product instance belongs.	
globalBusinessIdentifier	CDATA	#IMPLIED	A unique way to identify the business, such as its DUNS number.	
globalProductIdentifier	CDATA	#IMPLIED	A unique way to identify the product, such as its Global Trade Item Number (GTIN)	

Attribute Name	Type	Data Type	Description	Alias
traceabilityType	CDATA	#IMPLIED	The batch-size of the data being collected. This can be SERIAL, LOT, VENDOR, etc.	
manufacturerName	CDATA	#IMPLIED	The name of the manufacturer of the component product in the assembly.	
globalLocationIdentifier	CDATA	#IMPLIED	This indicates which site the product was built at. This implies that all manufacturing locations have a unique identifier to fill in this value.	
globalCountryCode	CDATA	#IMPLIED	Code identifying the two character country code specified in ISO 3166-1993 for the country of origin where the product was manufactured.	
productRevision	CDATA	#IMPLIED	The manufacturing revision identity that indicates a special revision of the product being built. For example, a motherboard with different revision based on design changes.	
productVersion	CDATA	#IMPLIED	The manufacturing version number that indicates if a specific version of the product is used.	
buildDate	DATE	#REQUIRED	The manufacturing date and time stamp which indicates when the component product was built.	
materialIdentifier	CDATA	#REQUIRED	Material ID. This is the manufacturer internal number for identifying the component product.	
forecastProductIdentifier	CDATA	#IMPLIED	This field is the sales or catalog name for the product if one exists.	
purchaseOrder	CDATA	#IMPLIED	Purchase Order	EDI X12 V4010: 856 PRF01 – Purchase Order Number RN PIP3A4 Purchase Order Document Reference Proprietary Document Identifier.
purchaseOrderLineItem	CDATA	#IMPLIED	Number which identifies which part was ordered.	EDI X12 V4010: 856 LIN06 – Id 235 Code:PL – Purchaser's Order Line Number RN PIP3A4 buyerLineItem.LineNumber
authorizationLineItem	CDATA	#IMPLIED	Number which identifies which part was authorized.	EDI X12 V4010: 856 ISA02 – Authorization Information
customerSerial	CDATA	#IMPLIED	Number which identifies production item. This number can be provided by the customer or assigned using algorithms provide or approved by the customer.	
customerPart	CDATA	#IMPLIED	Customer Part Number. The customer part number is assigned and used by the customer to identify their part.	
customerRevision	CDATA	#IMPLIED	The revision of the product specified by the customer.	
customerVersion	CDATA	#IMPLIED	The version of the product specified by the customer.	

Attribute Name	Type	Data Type	Description	Alias
sequenceNumber	CDATA	#IMPLIED	The sequence/build of the product manufactured.	
manufacturingPartStatus	CDATA	#IMPLIED	The status of the product being manufactured.	

Additional Elements:

The following elements are (optionally) associated with and provide additional information about a given ProductInstance element. These elements are used to track special activities associated with a product instance such as the collection of lot information collected, the inclusion of configuration specifications, sub-assemblies tied to a manufacturing / workorder or any special packaging requirements.

ELEMENTNAME	MINOCCUR	MAXOCCUR	DESCRIPTION	ALIAS
Configuration	0	*	Configuration information	
Lot	0	1	Lot Information	
WorkOrder	0	*	Work Order Information	
Packaging	0	1	Packaging Information	
Process	0	*	Process routing information	

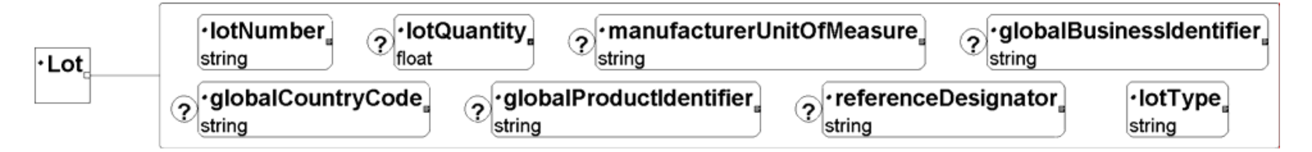
**All elements are optional. There may be more elements added by each manufacturer of the component.

7 Configuration Element

Configuration — configurationType string — configurationData string

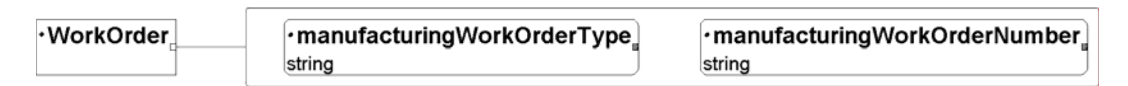
Attribute Name	Type	Data Type	Description	Alias
configurationType	CDATA	#REQUIRED	Type of configuration	
configurationData	CDATA	#REQUIRED	Configuration Data	

8 Lot Element



Attribute Name	Type	Data Type	Description	Alias
lotType	CDATA	#REQUIRED	Lot Type	
lotNumber	CDATA	#REQUIRED	The recorded serial number (or lot code) of the item	
lotQuantity	CDATA	#IMPLIED	Product quantity contained within lot	
manufacturerUnitOfMeasure	CDATA	#IMPLIED	Lot Unit of measure for item (gallons, inches, etc.)	
globalBusinessIdentifier	CDATA	#IMPLIED	Manufacturer's DUNS	
globalCountryCode	CDATA	#IMPLIED	Code identifying the two character country code specified in ISO 3166-1993 for the country of origin where the product was manufactured.	
globallProductIdentifier	CDATA	#IMPLIED	Lot Global trade Item Number (GTIN)	
referenceDesginator	CDATA	#IMPLIED	Reference Designation of the item	

9 WorkOrder Element



Attribute Name	Type	Data Type	Description	Alias
manufacturingWorkOrderType	CDATA	#REQUIRED	Manufacturing Work Order Type. Examples may include “Internal MRP”, ”Customer Specified”, and “Outsourced”..	
manufacturingWorkOrderNumber	CDATA	#REQUIRED	Manufacturing Work Order Number. This is the number assigned to a group of serial numbers all manufactured within a given set of options and configurations.	

10 Packaging Element



Attribute Name	Type	Data Type	Description	Alias
packagingUniqueIdentifier	CDATA	#REQUIRED	Packaging Unique Identifier	
cartonIdentifier	CDATA	#IMPLIED	Packaging Carton Identifier	
palletIdentifier	CDATA	#IMPLIED	Packaging Pallet Identifier	

11 Process Element



Attribute Name	Type	Data Type	Description	Alias
stepIdentifier	CDATA	#REQUIRED	Process Step Identifier	
processDateTime	CDATA	#IMPLIED	Process Date/Time. Specifies an instance in time.	Based on the ISO 8601 specification where "CC" represents the century, "YY" the year, "MM" the month and "DD" the day. The letter "T" is the date/time separator and "hh", "mm", "ss.sss" represent hour, minute and second respectively. This representation is immediately followed by a "Z" to indicate Coordinated Universal Time. Informal format: CCYYMMDDThhmmss.sssZ
operation	CDATA	#IMPLIED	Process (also referred to as Task or Operation)	
resource	CDATA	#IMPLIED	Process Resource or Machine	
router	CDATA	#IMPLIED	Process Router name or id.	

Appendix A – IPC Web-based Standards (IPC25XX)

The web-based standards (IPC 25XX) are designed to foster application integration and electronic commerce through data and information interchange standards based on XML. There is no need for a common object model, programming language, network protocol, persistent storage mechanism or operating system for two applications to exchange XML messages formatted using the web-based standards. The two applications simply need to be able to format, transmit, receive and consume a standardized XML message.

A web-based standards series has been identified for each of the value-added activities occurring throughout the product life cycle of an electronics product. The web-based standards are:

IPC-2500 – Framework Standard

IPC-2510 – Product Data Representation

IPC-2520 – Product Data Quality

IPC-2530 – Surface Mount Equipment Standard Recipe File Format

IPC-2540 – Shop Floor Equipment Communications

IPC-2550 – Manufacturing Execution Systems Communications

IPC-2560 – Enterprise Resource Planning Systems Communications

IPC-2570 – Supply Chain Communications

Table A-1 shows the correlation of the different standards in each of the series. Although not every standard has been started, the figure represents a coordinated opportunity to maintain consistency throughout the standard development cycle.

Table A-1 CAD/CAM Standardization

IPC Number/ Function	-xxx1 Generic	-xxx2 Administ	-xxx3 Documnt	-xxx4 Board Fabricat	-xxx5 Bare Bd Test	-xxx6 Assy Manufac	-xxx7 Assy/ Test/ Insp.	-xxx8 Comp. & Material	-xxx9 Informa. Modeling
IPC-2500 CAMX Framework	IPC-2501 PINS								
IPC-2510 GenCAM Product Data	IPC-2511A (Pub)	IPC-2512A (Pub)	IPC-2513A (Pub)	IPC-2514A (Pub)	IPC-2515A (Pub)	IPC-2516A (Pub)	IPC-2517A (Pub)	IPC-2518A (Pub)	IPC-2519A (Pub)
IPC-2520 Quality Product Data				IPC-2524 (Pub)					
IPC-2530 SRFF Process Data Recipe file	IPC-2531 ANSI Draft								
IPC-2540 Shop Floor Communicate	IPC-2541 (Pub)					IPC-2546 (Pub)	IPC-2547 2nd IF		
IPC-2550 Execution Communicate	IPC-2551 PINS			IPC-2554 Working draft		IPC-2556 PINS			
IPC-2560 Enterprise Communicate									
IPC-2570 Supply Chain Communicate	IPC-2571 (Pub)					IPC-2576 (Pub)	IPC-2577 Proposal	IPC-2578 (Pub)	

